APPENDIX B

TIMBER INVENTORY

B-1. Definition. Timber inventory is a field procedure that provides information concerning the timber volume of a designated area and other characteristics of the forest and land. It is a sampling process which ranges in intensity from 100 percent downwards.

B-2. Purpose and Objectives. To prepare plans for the intelligent management of forest properties, an initial inventory of all timber is desirable. Such an inventory includes the quantity and quality of forest trees, their growth, and the characteristics of the land. It should follow a land use survey in order to encompass such nonwood values as aesthetics, recreation, watershed protection, and wildlife management, in coordination with the military mission of the installation. Subsequent inventories should be made at the following times during the implementation of the forest management plan:

B-a. At periodic intervals, the volume data, timber growth, timber drain, and land use changes should be brought up-to-date.

B-b. Prior to any harvesting and sale of forest products, the volume and value of the trees to be cut should be ascertained.

B-2.3. In the event of trespass or fire, the volume and value of the trees should be determined for proper record-keeping and possible litigation.

B-2.4. In the event of sale, disposal, or exchange of government-owned lands, a timber inventory should be one of the bases for determining value.

B-3. Inventory Procedures. The first step in a timber inventory is to prepare a base map, generally at a scale of 4 inches to the mile. Topographic features such as roads, trails, railroads, water bodies and courses, improved grounds, firing ranges, impact areas, antenna fields, ammunition areas, and other areas not in the forest acreage should be placed on the base map. This data can be found and transferred from other government topographic maps and from aerial photographs.

B-3.1. Compartments. For the purpose of managing forest lands, the area should be divided into compartments. Compartments should be defined on the base map by permanent boundaries (fig. B-1). These can be natural or man-made features such as ridges, streams, roads, railroads, reservation boundaries, or other clearly defined physical lines. All compartments on the base map should be identified numerically. One compartment should be established for each year of the cutting cycle. The number of compartments established will range from five to ten, depending upon the rate of growth (the cutting cycle should be established as ten years when not determined by other methods). The compartments should be approximately equal in area, if feasible. Legal subdivisions should be used if they are convenient. Military subdivisions are useful in some instances. A timber type map at a scale of eight inches to the mile should be prepared for each compartment. Various timber types can be transferred to the compartment map from aerial photographs and supplemented with data from a follow-up timber cruise. Supplemental data should include stand density, size classes, age classes, subspecies, site index, and forest suitability determinations.

B-3.2. Cutting Units. Individual compartment maps showing timber types should be further divided into cutting units, 40 to 80 acres in size. The cutting units are used as record units for timber inventory, timber marking, cultural operations, and timber sales. Cutting units should be identified by numbers, starting a new series for each compartment (fig. B-1). In some systems of management (Air Force and Navy), the stand, or block, is used as the basic record unit rather than the cutting unit.

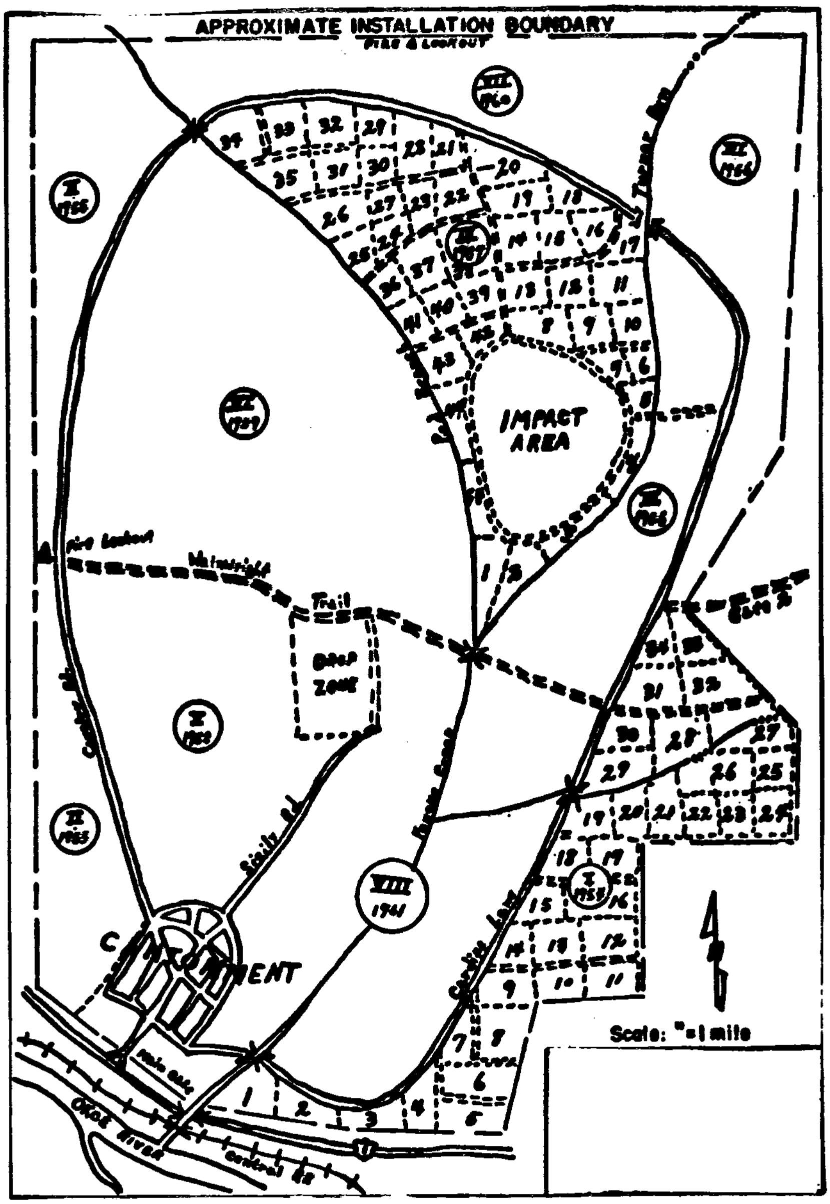


Figure B-1. Compartments and cutting units/stands or blocks

B-3.3. Aerial Photography. Timber types and identification, as well as stand condition classes, can best be delineated and transferred to a compartment timber type map by the use of aerial photography. For the purpose of type mapping, 9″ × 9″ contact prints should be obtained for stereoscopic examination (fig. B-2). Black and white pancromatic and infrared film are used for most government photography. If military photographs are too old, more recent photographs can be obtained from other government sources: the Agricultural Stabilization and Conservation Service, Forest Service, and Soil Conservation Service of the U.S. Department of Agriculture, and certain state forestry agencies. Maps showing areas covered by aerial photography in the United States are available upon request from the U.S. Geological Survey. If supporting military aircraft are available, the installation's forests can be flown and photographed, using false color film. This film, known as "Color Infrared, Camouflage Detection, Kodak Aerocrome Infrared Type 2443", has proven the most satisfactory for forest type identification and classification.

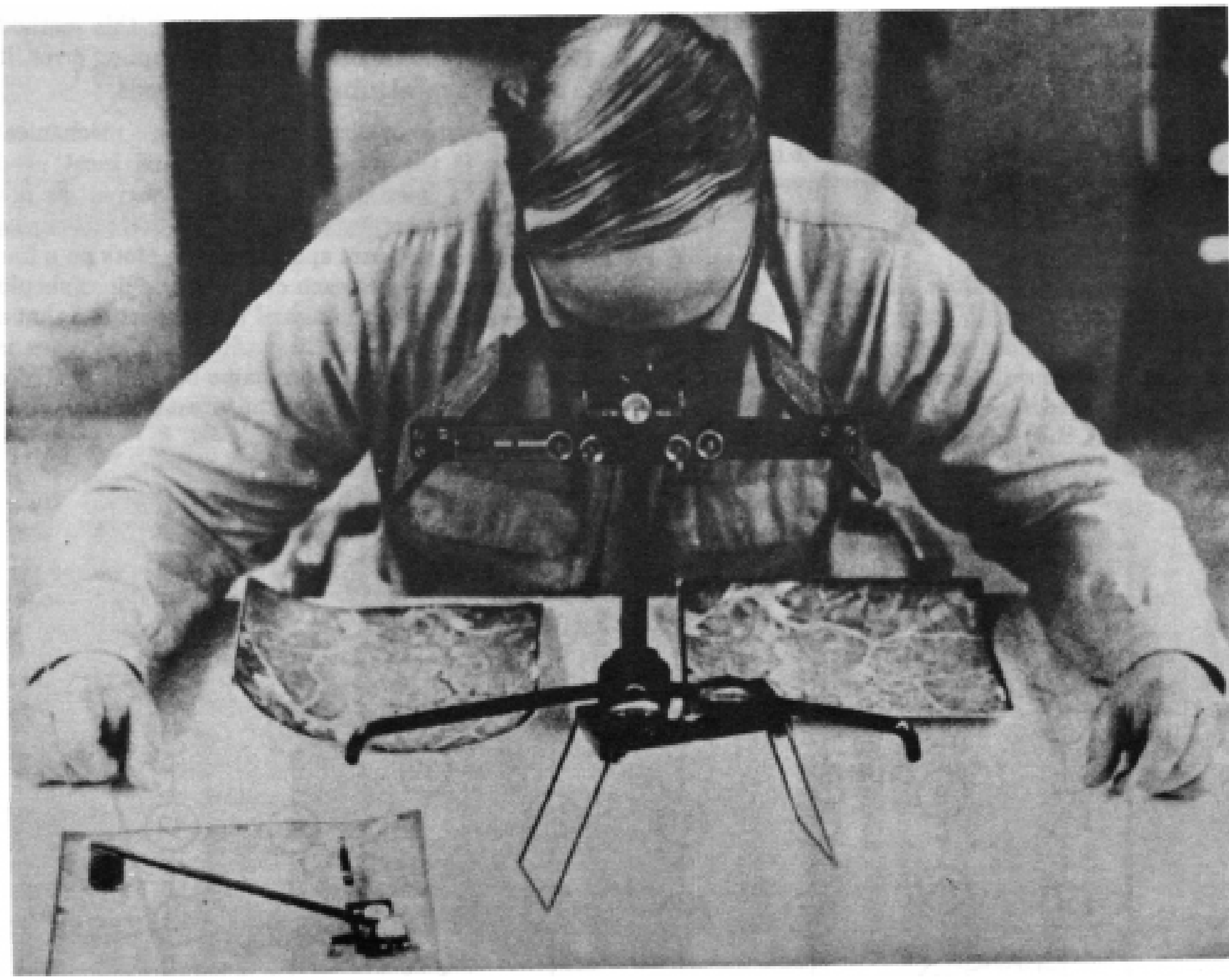


Figure B-2 Examining aerial photographs under stereoscope.

B-3.4. ***Photo Interpretation and Mapping.*** **To delineate the various timber types and classifications, the delineation lines must be drawn under a stereoscope. After the types have been delineated, the desired detail can be transferred toa compartment map by using a vertical sketch master.**

B-3.5. ***Suggested System of Type and Size Classes.*** **A standardized symbol system for various classifications and information about each timber type is shown in Table B-l. If timber type data is to be processed by machine methods, the various types are given individual numbers. A numbering system or code is contained in the Forest Survey Handbook available from the regional offices of the Forest Service. The photo interpreter may not be able to differentiate each classification on the aerial photograph the classification can be completed and corrected, if necessary, from data obtained during the timber cruise. In addition to the timber types and classification, noncommercial forest land should also be delineated and transferred to the timber type map. Forested areas which may require special management treatment are: recreational areas, natural or unique areas, threatened and endangered species habitats, water bodies and courses, wetlands, protective strips, and roadside aesthetic strips.**

B-4. Sampling.

B-4.1. ***Sampling Design Timber*** **cruising is essentially a sampling process. The intensity of sampling is determined by the size of the area being inventoried, the purpose of the inventory, and the degree of accuracy needed. Another factor that influences the degree of sampling is the variability of the timber as to condition, size, density, and uniformity of stocking. Since timber is becoming increasingly valuable, the percentage of error of atimber cruise should be kept low. For purposes of management planning, a sampling error of 10-15 percent is allowable. When timber is cruised for the purpose of a clear-cut timber sale, the results should**

fall within a five percent allowable error. With the exception of 100-percent sampling in which all the trees are measured, the sampling area may be a circular plot, strip, or point sample. The most common plot sizes used in inventorying are one-fourth, one-fifth, and one-tenth acre. There are three systems of sampling design: random, systematic, and stratified.

B-4.1.1. Random. Random sampling is a system where the locations of the sampled plots are established by random selection. An overlay grid is superimposed over the map or photograph of the area to be cruised. Once the number of sample plots is determined, they are located on the grid by using a table of random numbers. Although this method facilitates the computation of the sampling error, it is not as practical to use as other methods.

B-4.1.2. Systematic. Systematic or mechanical sampling is the most practicable and most used system in timber cruising. The sampling pattern is a definite grid, whereby the lines of plots (cruise lines) are the same distance apart, and the plots on a line are equidistant from each other. Cruise lines should be run across the drainage of the property so that a good cross section of the various timber types is sampled. This method eliminates bias and provides a more uniform coverage of the forest (fig. B-3).

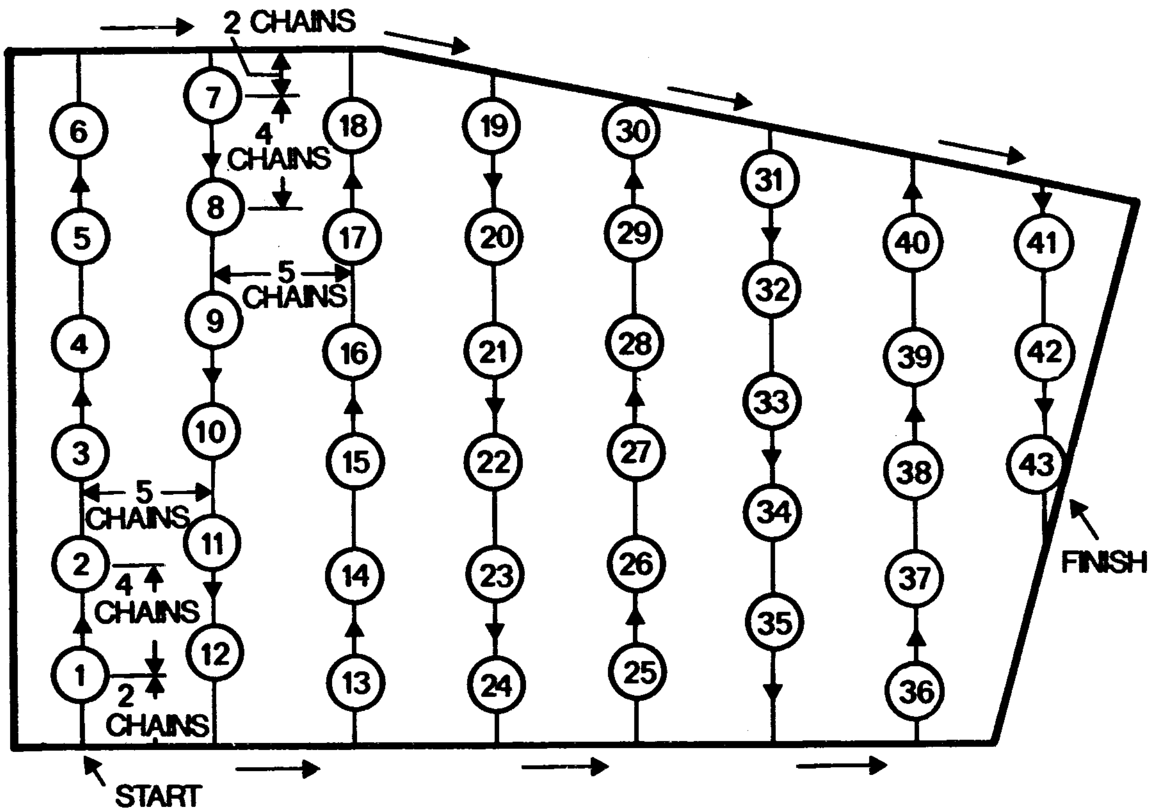


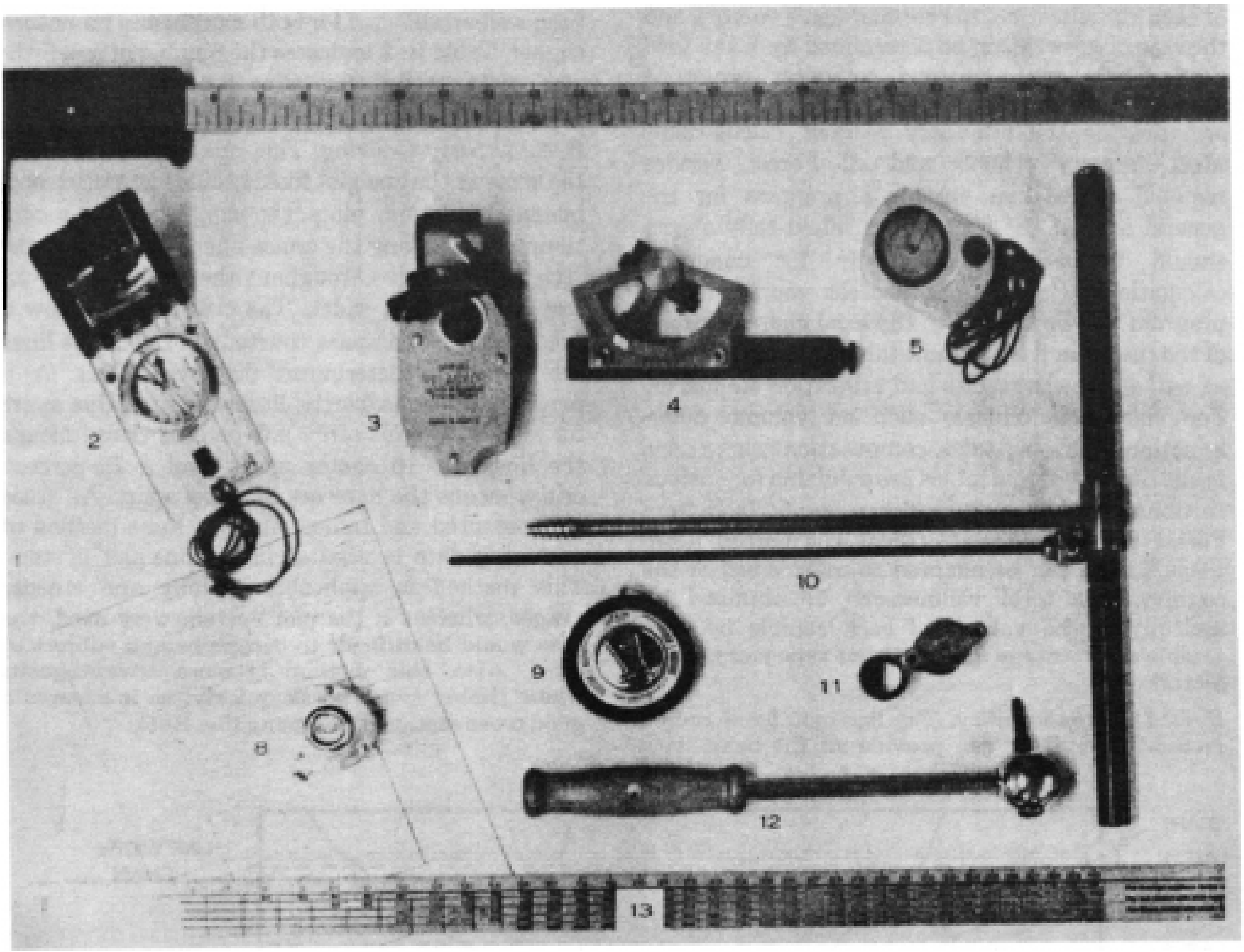
Figure B-3. Diagrammatic plan for a 10-percent systematic line-plot cruise utilizing one-fifth-acre circular samples.

B-4.1.3. Stratified. Stratified sampling combines the features of aerial and ground estimates. Photographs or type maps are used for area determination of each major timber type. The number of sample plots to be measured on the entire tract is predetermined. The plots are then located on each predominant timber type by proportional allocation. The distribution of the plots is in proportion to the area of each type. All field plots taken on each type should be located by random selection, both on the photographs and type map, and then on the ground.

B-4.2. Methods of Sampling and Inventory. When the intensity of the timber cruise and the sampling design have been determined, one of the four methods of sampling can be chosen: fixed radius plots, strip cruising, variable plot or point sampling, and three-P sampling.

B-4.2.1. Fixed Radius Plots. Line-plot cruising is the systematic measuring and tallying of all trees on a series of sample circular plots laid out in a grid pattern. The cruise lines are run at uniform spacing, and the plot centers are located at predetermined intervals along each cruise line. Plots are usually one-fifth acre in size (with a 52.7-foot radius). Sometimes a one-tenth-acre plot (with a 37.2-foot radius) is used for dense pole and smaller size timber. The distances between cruise lines and between plots are predetermined by the percent or intensity of the sample.

B-4.2.1.1. Field Procedure. The first step in the field is to determine the compass direction of the cruise lines so that the topography will be crossed by the lines. Running the line parallel to one side of the tract (compartment) is desirable, if possible. Distances between plot centers are located by chaining or pacing. Once a plot center is located, the perimeter must be located by chain measurement of the plot radius (fig., B-4).



1. Calipers for diameter measurement
2 Compass
3. Relaskop
4. Abney level
5. Clinometer with range finder
6. Prism
7. Tally sheet
8. Tally meter
9. Diameter tape
10. Increment borer
11. 10X hand kns for ease in reading growth rings
12 Increment hammer
13. Tree scale stick

Figure B-4 Forestry instruments used in inventory and harvest calculations.

B-4.2.1.2. Data-Gathering.

B-4.2.1.1.1. Measure the Diameter at Breast Height (DBH) and tally all trees with a DBH of 5-inches and over; estimate merchantable height; and classify as to species and utilization (e.g., pulpwood, sawtimber, poles, piling and peeler logs).

B-4.2.1.2.2. Record the cut or leave trees for **a** Timber Stand Improvement (TSI) cut or a first partial harvest.

B-4.2.1.2.3. Bore and record sample trees of different sizes (2 to per plot) to determine age, rate of growth, merchantable and total height, from which site classification as well as future growth can be ascertained.

B-4.2.1.2.4. Make a reproduction count of trees 4 inches in diameter and smaller on an inner one one-hundredth-of-an-acre plot (with an 11.8-foot radius).

B-4.2.1.2.5. Record observation of timber types and ground conditions.

B-4.2.1.3. Volume Determination. The total volume of each classification, the cut-and-leave volume, and the rate of growth can be determined from the field data. There are numerous computer programs already designed and available that can simplify and provide the necessary readout calculations. Most forestry schools and all Forest Service regional offices can provide a program for the general area of the installation. Field tally sheets should be designed especially for computer calculations. Contact the nearest source, as its program will be slanted to the local characteristics of the timber and the volume tables used in the area, as well as growth results and utilization standards. For small-area cruises, such as volume determination for timber sales, computation can be done in the office. Volume tables are available for various sections of the country and can be obtained from Forest Service regional offices. The Girard Form Class Tables can be adapted to most areas of the country. The total volume can be obtained by multiplying the volume of each sample by that sample's percentage of the timber type (conversion factor).

B-4.2.1.4. Applicability. The line-plot fixed radius method of cruising can provide all the basic data needed for preparation of an overall timber management plan. It is a simple method to use and can be applied to large- or small-area inventories. Because there is a record of data for each individual plot, it is a simple matter to extract the volume and other information for each individual timber stand or type. The sampling accuracy of this method has been well-established for both mature and immature timber. Table B-2 indicates the number of one-fifth-acre plots needed for three common degrees of accuracy.

B-4.2.2. Strip Cruising. This method is essentially the same as the line-plot fixed radius method except, instead of circular plots, the sample area is a continuous strip along the cruise line. The width of the strip is the same throughout the cruise, either 33 feet or 66 feet in width. The cruise lines follow a predetermined compass course, and the cruise lines are spaced predetermined distances apart. A 5 percent cruise means the lines are 20 chains apart for a 66-foot-wide strip; a 0-percent cruise means the lines are 10 chains apart; and a 20-percent cruise means the lines are 5 chains apart. All trees are measured and tallied, and the same method of gathering data is used as in the line-plot system. This method is applicable to hilly and steeper ranges, whereas if the plot system were used, the area would be difficult to determine and subject to error. Also, this method is more advantageous where timber types break quickly, as it assures a good cross section of sampling (fig. B-5).

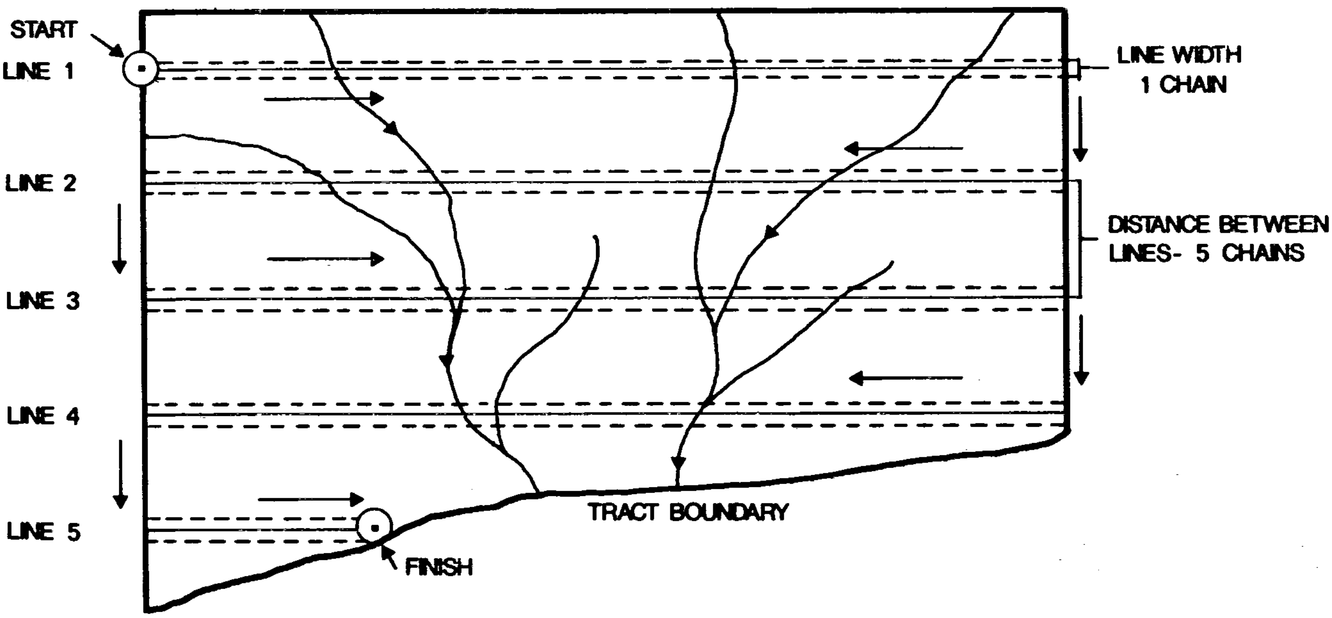


Figure B-5. 20 percent strip cruise.

B-4.2.3. Variable Plot or Point Sampling. Point sampling is a method of selecting trees to be tallied on the basis of their size rather than their frequency of occurrence. In plot sampling, the probability of tree selection is proportional to tree frequency; in point sampling, it is proportional to tree basal area. Variable plots do not require the measurement of the plot radius or tree diameters to compute the basal area. Stem counts are tallied without regard to diameter. A tree whose diameter is large enough to subtend a fixed angle of a prism or angle gauge of a specified basal area factor is tallied as "in" the plot (fig. B-6). Each tree carries equal weight in computing basal area per acre, regardless of its diameter. The Basal Area Factor (BAF) converts the stem count per acre to the basal area per acre. The count of each sample point, multiplied by the BAF, gives the total basal area in square feet of tree stems on a peracre basis. Precision-tested prisms that have an exact BAF simplify the computation. Prisms of BAF 10 are commonly used in the East for second-growth sawtimber or dense pole timber stands. BAF 5 is used in light-density pole stands, and BAF 20 for old-growth stands. In the western United States, prisms with a BAF 20 to 60 are in common usage. For acceptable results, a BAF should be selected for trees that will average a 5-to-12 tree count at each point. The number of sample points to be used depends on the average-size diameter of the timber being estimated; for example, for a 10-percent cruise of a 120-acre tract that has an estimated average tree diameter of 14 inches, the following formula gives the number of points necessary:

$$\frac{\text{Area of Tract} \times \text{\% Cruise}}{\text{Basal Area of Average Tree}} \times \text{BAF} = \text{Number of Points Necessary}$$

$$\frac{120 \times 10\%}{1.069} \times 10 = 112 \text{ Points}$$

An average diameter of 20 inches would require only 55 points. The smaller the average diameter, the more sample points will be necessary.

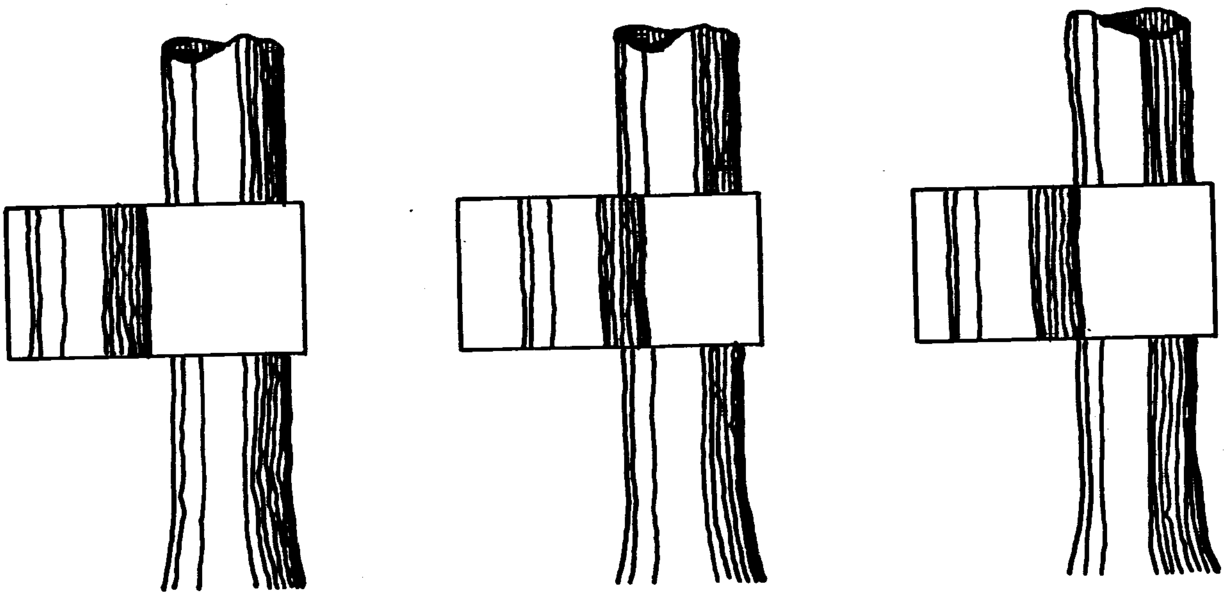


Figure B-6. Using prism to determine if tree is "in", "out", or borderline.

B-4.2.3.1. Field Procedure and Data-Gathering. Sampling methods which can be employed with fixed plots can also be used with point sampling. The points are analogous to plot centers; thus, the design can be random, stratified, or systematic sampling. At each point of sampling, by use of a prism or angle gauge instrument, the number of trees that fall in the imaged deflection are tallied (fig. B-7). If a simple overall volume per acre is desired, then only a tally of trees by product type is necessary. If additional information is required, then a complete field tally is in order in which every sample tree is measured for height and DBH as well as surveyed to obtain the grade, form class, product class, and even crown class. Such a complete measurement system is ideal for computer processing. Porta-Punch cards are best adapted **for** this type of computer computation (figures **B-8, B-9** and **B-10.**

Figure B-7. Use of prism in variable plot cruising.

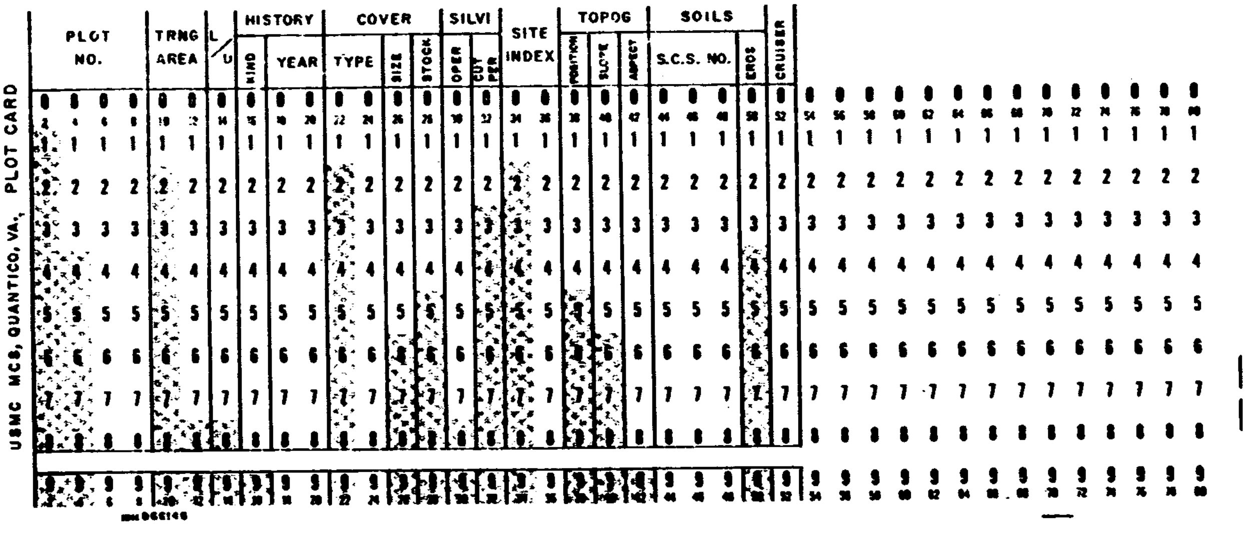


Figure B-8. Data processing punch card for individual plot for CFI.

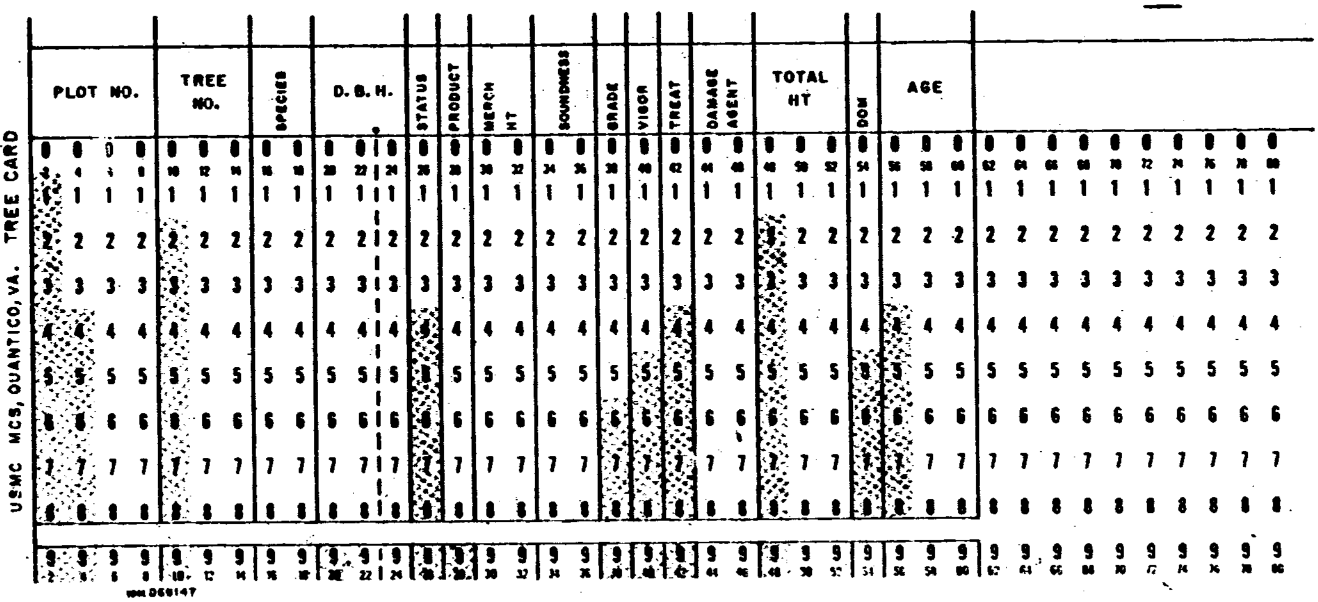


Figure B-9. Data processing punch card for individual tree for CFI.

```
COUNTY  115LOCATION   18

                                                      SAMPLE LOCATION SUMMARIES

SUM(1) =    417.6763 NUMBER OF LIVE TREES PER ACRE
SUM(2) =     86.1119 LIVE TREE STOCKING
SUM(3) =    343.5313 NET CU.FT. VOL. PER ACRE
SUM(4) =    196.2887 NET CU.FT. VOL. IN SAWLOG PORTION
SUM(5) =     37.6270 ANNUAL INCREASE IN NET BD.FT. VOL.
SUM(6) =     12.3418  ANNUAL INCREASE IN NET CU.FT. VOL.
SUM(7) =    598.7313 NET BD.FT. VOL. PER ACRE
SUM(8) =     26.0009 SQUARE FEET OF BASAL AREA
                                                     PROPORTION OF STOCKING BY SPECIES
                       6      .1510
                      22      .0348
                      29      .0498
                      39      .1231
                      46      .2323
                      49      .0627
                      50      .0453
                      64      .3021

RECORDED TYPE IS   53  COMPUTED TYPE IS   53
                                                     PROPORTION OF STOCKING BY TREE SIZE CLASS
STAND(1) =        .8927 SEEDLINGS AND SAPLINGS
STAND(2) =        .0000 POLE TIMBER
STAND(3) =        .1073 SAWTIMBER
                                                      STOCKING BY TREE AND COVER CLASS
COND(1) =     26.6000 DESIRABLE TREES
COND(2) =     51.7119 ACCEPTABLE TREES
COND(3) =      3.9000 ROUGH TREES
COND(4) =      3.9000 ROTTEN TREES
COND(5) =       .0000 INHIBITING VEGETATION
COND(6) =     10.0000 NONSTOCKED
COND(7) =       .0000 NONSTOCKED AND OVERTOPPED
COND(8) =       .0000 NONSTOCKABLE

AREA CONDITION =   61STAND SIZE =    40


NUMBER OF OVERSTOCKED POINTS = 2

   19 = NUMBER OF RECORDS FOR SAMPLE LOCATION
COUNTY  115LOCATION   18
```

ST 4	SU 5	CO 6	PLOT 7	PT 24	TR 25	HIST 26	SP 27	TC 59	DBH 28	DBHI 29	BL 30	CFC 31	SL 32	TDOB 33	BFC 34	NOTR 60	STOCK 61	CF 62	CFSL 63	BFI 64	CFI 65	BF 66	BA 67	PO 100
28	2	115	18	1	0	0	0	6	.0	.00	0.	0.	0.	.0	0.	.0	10.0	.0	.0	.0	.0	.0	.0	0
28	2	115	18	2	1	1	611	3	13.3	.19	50.	0.	27.	9.0	0.	3.9	3.9	78.0	60.1	.0	2.6	.0	3.7	1
28	2	115	18	2	2	1	491	2	2.6	.00	5.	0.	0.	.0	0.	100.0	1.4	19.2	.0	.0	.0	.0	3.7	2
28	2	115	18	2	3	1	491	2	1.9	.00	6.	0.	0.	.0	0.	100.0	.8	10.4	.0	.0	.0	.0	2.0	3
28	2	115	18	3	1	1	521	2	2.8	.00	10.	0.	0.	.0	0.	100.0	5.4	26.9	.0	.0	.0	.0	4.3	1
28	2	115	18	3	2	1	61:	2	1.4	.00	6.	0.	0.	.0	0.	100.0	5.4	5.7	.0	.0	.0	.0	1.1	2
28	2	115	18	4	1	1	131	1	3.0	.00	0.	0.	0.	.0	0.	.0	6.5	.0	.0	.0	.0	.0	.0	2
28	2	115	18	4	2	1	131	1	3.2	.00	0.	0.	0.	.0	0.	.0	6.5	.0	.0	.0	.0	.0	.0	1
28	2	115	18	4	3	1	68	1	2.2	.00	0.	0.	0.	.0	0.	.0	3.0	.0	.0	.0	.0	.0	.0	3
28	2	115	18	5	1	1	931	2	3.1	.00	0.	0.	0.	.0	0.	.0	6.5	.0	.0	.0	.0	.0	.0	1
28	2	115	18	5	2	1	931	2	3.1	.00	0.	0.	0.	.0	0.	.0	6.5	.0	.0	.0	.0	.0	.0	2
28	2	115	18	6	1	1	611	2	11.8	.19	48.	1.	20.	9.0	10.	4.9	4.2	70.9	46.5	10.8	2.9	209.6	3.7	1
28	2	115	18	7	1	1	837	2	11.7	.26	42.	0.	20.	11.1	0.	5.0	4.2	92.5	62.8	26.8	5.0	389.1	3.7	1
28	2	115	18	8	1	1	802	1	2.0	.00	0.	0.	0.	.0	0.	.0	5.4	.0	.0	.0	.0	.0	.0	1
28	2	115	18	8	2	1	491	2	1.9	.00	0.	0.	0.	.0	0.	.0	5.4	.0	.0	.0	.0	.0	.0	2
28	2	115	18	8	3	1	802	1	1.5	.00	0.	0.	0.	.0	0.	.0	5.2	.0	.0	.0	.0	.0	.0	3
28	2	115	18	9	1	1	316	4	13.4	.26	42.	5.	18.	9.8	0.	3.8	3.9	39.8	26.9	.0	1.9	.0	3.7	1
28	2	115	18	10	1	1	611	2	3.6	.00	0.	0.	0.	.0	0.	.0	6.5	.0	.0	.0	.0	.0	.0	1
28	2	115	18	10	2	1	621	2	1.4	.00	0.	0.	0.	.0	0.	.0	5.4	.0	.0	.0	.0	.0	.0	2
																417.7	96.1	343.5	196.3	37.6	12.3	598.7	26.0	

Figure B-10. Sample data processing print-out showing pertinent information.

B-4.2.3.2. Volume Determination. The volume of sample areas is derived from a ratio between the tree and its basal area. This is done by multiplying the average basal area per acre by the average Volume Basal Area Ratio (V-BAR). The V-BAR can be obtained from V-BAR tables which show the gross volume per square foot of basal area at the point of measurement, by diameter and height classes, and sometimes by form class. These tables are available from many sources, including Prism Cruising in the Western United States and Volume Tables for Use Therewith (App K, No. 52) and Log Scaling and Timber Cruising (App K, No. 53).

B-4.2.3.3. Applicability. This method is much quicker and lower in cost than other previously mentioned methods. The number of measured trees in each plot is considerably smaller. It is very adaptable to dense stands of small trees, especially when only the merchantable volume is desired. It has its drawbacks in areas of heavy underbrush and steep terrain. Its use in preparing an overall management plan can give an erroneous picture of the true stocking of small-size trees, which are in turn the basis for future ingrowth. The small sizes receive a much smaller percentage of sampling than the large sizes.

B-4.2.4. Three-P (Probability Proportional to Prediction) Sampling. This is a unique method of sample tree selection and volume determination, using precision measuring equipment, and lends itself to computer processing. The volume obtained by the Three-P system utilizes an extremely small sample of trees.

B-4.2.4.1. Sample Plots. Sample plots are selected randomlyntensity of the sample is based on the Coefficient of Variation (CV) which is a ratio of the standard deviation to the mean of the population. CV can be estimated from old inventories. In a CV of 20 percent with a desired sampling error of two percent, only 100 Three-P sample trees would have to be measured.

B-4.2.4.2. Selection of Sample Trees. Sample trees for actual measurement are selected by the prediction of volume and height for that tree with a computer-generated list of random numbers. The random numbers may be selected in the field by taking a random integer list to each plot as it is established.

B-4.2.4.3. Dendrometry Procedure. The Bar and Stroud Dendrometer is the most efficient instrument to use in measuring stem diameters and lengths of selected trees. The dendrometer is used to measure the diameter at breast height and at intervals up the stem to a minimum, predetermined top diameter. All diameters are taken outside the bark; the inside bark diameter (dib), for accurate volume computation, is computed through the use of dib-relationships and bark-thickness ratios. The volume and grade of each section can be computed for any type of unit measure.

B-4.2.4.4. Applicability. The use of the Three-P system has proven its accuracy, particularly on timber to be sold on a tree basis. It requires the availability of personnel trained in dendrometer measuring as well as the availability of computer programs. Although only a small number of trees need be measured, the technique does not reduce the number of trees to be visited in the overall inventory. The method is structured for volume determination rather than for all the other variables needed in proper resource management.

B-5. Continuous Forest Inventory (CFI).

B-5.1. Purpose and Characteristics. CFI is a system of permanently established sample plots that are periodically remeasured to update data necessary for the management of forest resources. The plots are systematically located so that the data obtained are a true representation of the changes that occur in the surrounding forest. These data provide the up-to-date basis for forest resource management decisions.

B-5.2. Plot Location. To determine the number of plots to be established, a statistical determination of sampling intensity is recommended. However, a rule of thumb which indicates the approximate number of plots that can be established can be used. The number is equal to 100+ .0025 × number of acres. From this formula, it can be seen that a minimum of 100 plots is needed for any size tract. For plot location, some form of stratified sampling, based on forest types and even topography, should be used. One-fifth-acre plots are the most efficient. A variable plot method can also be used.

B-5.3. Field Procedure. In this procedure, the necessary plots are first located, according to the sampling design, on the forest map and on the ground. The plot center is permanently marked by a driven metal stake, referenced by a metes and bounds survey from an easily-located starting point. All trees in the circular plot, 5 inches in diameter or larger, are numbered by either paint or metal tags. All trees are measured for diameter, pulpwood and sawlog heights, crown class, vigor, grade, operability, as well as growth data. The physical characteristics of the plot itself are also recorded, including the topography, site, density, forest cover, and stand condition. For proper recording and calculations, automatic data processing is required. All field data should be recorded on mark-sensed or punch cards in lieu of the usual field tally sheets. A tree card is needed for each tree, and one card is needed for each individual plot.

B-5.4. Remeasurement Interval. A remeasurement interval of 5 years, but no longer than ten, is recommended.

B-5.5. Applicability. Installations with 20,000 acres or more of commercial forest land, can justify the establishment of a CFI. To re-inventory the entire tract would be too costly as compared to the remeasurement of CFI plots. For installations with less than 20,000 acres of commercial forest land, the cost of remeasurement would justify a re-inventory on the same basis and using exactly the same methods as used in the original timber cruise without the need of a CFI system.

B-6. Allowable Annual Harvest.

B-6.1. General. In theory, the annual timber harvest is based upon the annual timber growth of the installation, the mortality loss from all sources, and the silvicultural needs of individual stands. All this information is derived from the overall timber inventory. However, changes occur due to military training requirements that alter the amount of timber available for cutting.

B-6.2. Application. Factors that affect the allowable annual cut include changing needs of the military mission of the installation, environmental considerations, conditions described in paragraph 1-2, and management of such special areas as those described in subparagraph B-3.5. The first priority in determining the amount of timber for harvest in the first phase of the cutting cycle is removal of mature or deteriorated trees and improvement of existing stands, but it must be recognized, of course, that only in extreme cases should the amount harvested exceed the net annual growth. Normally, the goal for all subsequent cutting cycles should be to maintain the annual harvest at a rate which is lower than the total net growth of the installation. This increases the productivity of the timberlands except in those instances where timber stands are already fully stocked.

B-6.3. Determination of Cut and Scheduling Program Cuts. To determine the actual allowable harvest, after taking into consideration other land uses, a cutting cycle should be established. Normally, this would be 10-year periods. Cutting plans covering longer periods may have to be revised due to changes in markets, utilization, road systems, logging methods and environmental reasons. During this time, the prescribed treatment of stands in all compartments should have been accomplished and the timber harvested as specified in the overall management plan. Prior to the sale of any timber, the volumes to be harvested from a cutting area should be accurately determined by the measurement of trees to be removed, or by a cruise of appropriate intensity if the area is to be clear-cut or cut back to seed trees. The original inventory can provide data to be extracted that will give the volume for each individual timber type. This figure will help in determining the amount of timber that a cutting area can and should provide.

B-6.4. Inventory Records. The installation's forest management plan should incorporate in table form the volume data produced by the overall installation inventory. Tables should summarize the total volume and predicted growth according to species and product for the entire installation. The management plan should also include a detailed breakdown for each compartment (Air Force and Navy use stand or block) showing not only total volumes but also volumes according to timber types, species, products, diameter and age classes, and growing sites. The acreage of each timber type should also be recorded. Current and up-to-date inventory data should be kept on compartment record sheets (fig. B-11). This should include the original volume, show changes in inventory due to harvesting and loss from other causes, and show volume gains due to growth. Silvicultural activities, with the acreages involved, should also be recorded on the record sheets. An installation base map should be maintained at a scale of 4 inches to the mile. The boundaries and identification of each compartment and stand or block (Air Force and Navy) should be shown on this map. Information concerning planned harvesting, areas already treated, and dates of actual timber harvests should be given for the appropriate compartment and stand or block (Air Force and Navy). This base map should be a visual record of timber harvests and silvicultural activities. Individual compartment maps, at a scale of 8 inches to the mile, should also be prepared. They will be essentially timber type maps as described in subparagraph B-3.1. All forest projects, including timber harvests, should be shown in the appropriate areas. Sale boundaries, past and present, should be delineated with treatment description, project number, and date of the activity.

SUGGESTED FORMAT
CURRENT TIMBER INVENTORY

INSTALLATION ____________________ COMPARTMENT NUMBER __________ 5-YEAR ROTATION

SPECIES AND PRODUCT	YEAR	VOLUME (b-o-y)[a]	PREDICTED ANNUAL GROWTH (Bd.Ft.)	TIMBER REMOVALS	MORTALITY FROM ALL CAUSES	VOLUME (e-o-y)[b]
Pine sawtimber	1975					
	1976					
	1977					
	1978					
	1979					
Hardwood sawtimber	1975					
	1976					
	1977					
	1978					
	1979					
Pine pulpwood	1975					
	1976					
	1977					
	1978					
	1979					

[a] b-o-y = beginning of year
[b] e-o-y = end of year

Figure B-11. Example of current timber inventory form.

B-7. Guide Specifications for Inventory Methods. Guidelines for using various inventory methods are outlined in table B-3.

Table B-1. Timber Type Classification Symbols

Species	Standard Size Class	Stand Density
Letter symbols: First letter of predominant species name, followed by first letter of secondary species name (at least 20 percent of stand)	Numerical symbols: 1 = seedlings and saplings, 0″ -5″ DBH[a] 2 = pole timber, 5″ - 11″ DBH 3 = small saw timber, 11″ - 21″ DBH 4 = large saw timber, 21″ DBH and larger	Bar Symbols: - poorly stocked, 10 - 39% = medium stocked, 40 - 69% ≡ well stocked, 70 - 100%

Stand Condition	Non-Forest Cover	Site Index
Letter symbols: X = recent clearcut, nonstocked X-O = old clearcut, nonstocked F = area deforested by fire Y = area deforested by other cause PL = plantation C = coppice R = residual stand after partial cutting	Letter symbols: A = agriculture G = grass or brush O = nonvegetative NCF = noncommercial forest	Numerical symbols: Symbol is generally shown in most forest areas by height of tree at a given age.

Examples:		
	LP4≡vp(80)	Loblolly pine, large sawtimber, well stocked and mixed with Virginia pine (over 20% of volume), on a site class of 80.
	PLD1≡1938	Planted stand of Douglas fir seedlings, planted in 1938.

[a] DBH is the standard abbreviation for Diameter at Breast Height which is taken at four and one-half feet above ground level.

Table B-2.
Number of Plots Needed for Three Common Degrees of Accuracy [a]
One-Fifth-Acre Plots, Uniformly Spaced

Condition of Stand	Uniform			Average			Patchy	
Stocking[b]	Good	Medium	Poor	Good	Medium	Poor	Medium	Poor
Area in acres	**Plus or minus 5% accuracy**							
40	57	109	160	89	133	171	160	185
160	73	185	400	133	267	480	400	600
640	78	223	640	152	356	873	640	1,371
5,000	80	238	775	159	394	1,145	775	2,190
10,000	80	239	787	159	397	1,172	787	2,290
100,000	80	240	799	160	400	1,197	799	2,389
Area in acres	**Plus or minus 10% accuracy**							
40	18	46	100	33	67	120	100	150
160	20	56	160	38	89	218	160	345
640	20	59	188	40	97	274	188	505
5,000	20	60	198	40	100	291	198	586
10,000	20	60	199	40	100	298	199	593
100,000	20	60	200	40	100	300	200	599
Area in acres	**Plus or minus 20% accuracy**							
40	5	14	40	10	22	55	40	86
160	5	15	47	10	24	69	47	126
640	5	15	49	10	25	73	49	143
5,000	5	15	50	10	25	75	50	149
10,000	5	15	50	10	15	75	50	150
100,000	5	15	50	10	15	75	50	150

Note: Two-thirds of cruises made will probably come within the indicated percentages of complete accuracy. One-third may exceed these percentages.

[a] "Three-Pee Sampling Theory and Program in 'THRP' for Computer Generation of Selection Criteria", L. R. Grosenbaugh, U.S. Department of Agriculture, Forest Service, June 1975.

[b] Good Stocking is 2/3-to-full stocking. Medium stocking is 1/3-to-2/3 full stocking. Poor stocking is less than 1/3 full stocking.

Table B-3.
Guide Specifications for Inventory Methods

Purpose of Inventory	Usable Inventory Methods
1. Initial inventory for overall management plan	Fixed radius plot Point sampling (Design: Systematic)
2. Timber inventory for sale purposes	
2.1. Clear cut or seed tree sales	Strip method Fixed radius plot Point sampling (Design: Systematic or stratified)
2.2. Selective harvest	
2.2.1. High timber values	100% tree measurement
2.2.2. Low timber values	100% tree marked with sample tree measurement
2.2.3. Heavily dense small timber	100% tree marked with sample tree measurement
3. Continuous Forest Inventory	
3.1. Plot establishment	Fixed radius plot Point sampling (Design: Systematic or stratified)
3.2. Plot remeasurement	Three–P or 100% measurement
4. Appraisals	
4.1. Damage on small areas	100% tree tally
2. Damage on large areas	Fixed radius plot Point sampling (Design: Systematic)
3. Land Sales or exchange	Fixed radius plot Point sampling (Design: Systematic)